Claims

1. A falling film evaporator through which a refrigerant is conveyed, the falling film evaporator comprising:

a shell defining an evaporator inlet and an evaporator outlet, the shell having a longitudinal length and a lateral width;

a tube bundle inside the shell; and

a distributor disposed above the tube bundle and being in fluid communication with the evaporator inlet and the evaporator outlet, the distributor including an inlet duct, an upper plate underneath the inlet duct, an intermediate plate underneath the upper plate and a lower plate underneath the intermediate plate, the inlet duct and the upper plate defining a first chamber therebetween that is in fluid communication with the evaporator inlet, the upper plate and the intermediate plate defining a second chamber therebetween, the intermediate plate and the lower plate defining a third chamber therebetween, the upper plate further defining a plurality of upper plate openings that place the first chamber in fluid communication with the second chamber, the intermediate plate further defining a plurality of intermediate plate openings that place the second chamber in fluid communication with the third chamber and the lower plate defining a plurality of lower plate openings so that the refrigerant from the evaporator inlet flows sequentially through the first chamber, through the plurality of upper plate openings, through the second chamber, through the plurality of intermediate plate openings, through the third chamber, through the plurality of lower plate openings, and then onto the tube bundle, the intermediate plate having an upwardly facing surface at least seventy-five percent of which is exposed to the refrigerant to permit substantially unobstructed horizontal flow across at least seventy-five percent of the upwardly facing surface.

2. The falling film evaporator of claim 1, wherein substantially all of the upwardly facing surface of the intermediate plate of the distributor is exposed to the refrigerant to permit substantially unobstructed horizontal flow across substantially the entire upwardly facing surface.

3. The falling film evaporator of claim 1, wherein a horizontal cross-section of the first chamber of the distributor has a substantially triangular shape.

4. The falling film evaporator of claim 1, wherein a horizontal cross-section of the first chamber of the distributor has a substantially trapezoidal shape.

5. The falling film evaporator of claim 1, wherein a horizontal cross-section of the first chamber of the distributor has a substantially rectangular shape.

6. The falling film evaporator of claim 1, wherein the plurality of upper plate openings comprise a series of laterally spaced-apart paired openings and wherein some of the laterally spaced-apart paired openings are laterally closer to an outer periphery of the first chamber than are other laterally spaced-apart paired openings.

7. The falling film evaporator of claim 1, further comprising a stiffener disposed within the first chamber and being attached to the inlet duct and the upper plate.

8. The falling film evaporator of claim 7, wherein the stiffener is centrally disposed within the first chamber.

9. The falling film evaporator of claim 1, further comprising a distributor baffle extending downward from the distributor to create a turn of greater than ninety degrees that refrigerant follows in traveling from the distributor to the evaporator outlet.

10. The falling film evaporator of claim 9, wherein the distributor baffle is spaced apart from the shell.

11. The falling film evaporator of claim 1, further comprising a suction baffle extending from the distributor toward the shell and defining a plurality of suction baffle openings through which refrigerant passes in traveling from the distributor to the evaporator outlet, the plurality of suction baffle openings being of various sizes.

12. The falling film evaporator of claim 11, wherein the plurality of suction openings include larger openings and smaller openings, wherein the smaller openings are closer to the evaporator outlet than are the larger openings.

13. A falling film evaporator through which a refrigerant is conveyed, the falling film evaporator comprising:

a shell defining an evaporator inlet and an evaporator outlet, the shell having a longitudinal length and a lateral width;

a tube bundle inside the shell;

a distributor disposed above the tube bundle and receiving two-phase refrigerant from the evaporator inlet, the distributor including an inlet duct, an upper plate underneath the inlet duct, a lower plate underneath the upper plate, the inlet duct and the upper plate defining a first chamber therebetween that is in fluid communication with the evaporator inlet, the upper plate and the lower plate defining a second chamber therebetween, the upper plate defining a plurality of upper plate openings that place the first chamber in fluid communication with the second chamber, the lower plate defining a plurality of lower plate openings such that the refrigerant from the evaporator inlet flows sequentially down through the first chamber, through the plurality of upper plate openings, through the second chamber, through the plurality of lower plate openings, and then down to the tube bundle; and

a distributor baffle, said distributor baffle extending downward from the distributor to create a turn of greater than ninety degrees that refrigerant follows in traveling from the distributor to the evaporator outlet.

14. The falling film evaporator of claim 13, wherein the distributor baffle is spaced apart from the shell.

15. The falling film evaporator of claim 13, further comprising a suction baffle extending from the distributor toward the shell and defining a plurality of suction baffle openings through which the refrigerant passes in traveling from the distributor to the evaporator outlet, the plurality of suction baffle openings being of more than one size.

16. The falling film evaporator of claim 15, wherein the plurality of suction openings include larger openings and smaller openings, the smaller openings being closer to the evaporator outlet than are the larger openings.

17. A falling film evaporator through which a refrigerant is conveyed, the falling film evaporator comprising:

a shell defining an evaporator inlet and an evaporator outlet, the shell having a longitudinal length and a lateral width;

a tube bundle inside the shell; and

a two-phase refrigerant distributor disposed above the tube bundle and being in fluid communication with the evaporator inlet and the evaporator outlet, the distributor including an inlet duct, an upper plate underneath the inlet duct, a lower plate underneath the upper plate, the inlet duct and the upper plate defining a first chamber therebetween that is in fluid communication with the evaporator inlet, the upper plate and the lower plate defining a second chamber therebetween, the upper plate defining a plurality of upper plate openings that place the first chamber in fluid communication with the second chamber, the lower plate defining a plurality of lower plate openings such that the refrigerant from the evaporator inlet flows sequentially through the first chamber, through the plurality of upper plate openings, through the second chamber, through the plurality of lower plate openings, and then down to the tube bundle; and

a suction baffle, said suction baffle being interposed between the distributor and the shell and defining a plurality of suction baffle openings through which refrigerant passes in traveling from the distributor to the evaporator outlet, the plurality of suction baffle openings being of more than one size.

18. The falling film evaporator of claim 17, wherein the plurality of suction openings include larger openings and smaller openings, wherein the smaller openings are closer to the evaporator outlet than are the larger openings.

19. The falling film evaporator of claim 17, further comprising a baffle which extends downward from the distributor to create a turn of greater than ninety degrees that refrigerant follows in traveling from the distributor to the evaporator outlet.

20. The falling film evaporator of claim 19, wherein the distributor baffle is spaced apart from the shell.

21. A falling film evaporator through which a refrigerant is conveyed, the falling film evaporator comprising:

a shell defining an evaporator inlet and an evaporator outlet, the shell having a longitudinal length and a lateral width;

a tube bundle inside the shell; and

a two-phase refrigerant distributor disposed above the tube bundle and being in fluid communication with the evaporator inlet and the evaporator outlet, the distributor including an inlet duct, an upper plate underneath the inlet duct, a lower plate underneath the upper plate, the inlet duct and the upper plate defining a first chamber therebetween that is in fluid communication with the evaporator inlet and is trapezoidal in horizontal cross-section, the upper plate and the lower plate defining a second chamber therebetween, the upper plate further defining a plurality of upper plate openings that place the first chamber in fluid communication with the second chamber and the lower plate further defining a

plurality of lower plate openings, refrigerant flowing from the evaporator inlet sequentially through the first chamber, through the plurality of upper plate openings, through the second chamber, through the plurality of lower plate openings, and then to the tube bundle.

22. A falling film evaporator through which a refrigerant is conveyed, the falling film evaporator comprising:

a shell defining an evaporator inlet and an evaporator outlet, the shell having a longitudinal length and a lateral width;

a tube bundle inside the shell; and

a two-phase refrigerant distributor disposed above the tube bundle and being in fluid communication with the evaporator inlet and the evaporator outlet, the distributor including an inlet duct, an upper plate underneath the inlet duct, a lower plate underneath the upper plate, the inlet duct and the upper plate defining a first chamber therebetween that is in fluid communication with the evaporator inlet and is triangular in horizontal cross-section, the upper plate and the lower plate defining a second chamber therebetween, the upper plate defining a plurality of upper plate openings that place the first chamber in fluid communication with the second chamber and the lower plate defining a plurality of lower plate openings such that the refrigerant from the evaporator inlet flows sequentially through the first chamber, through the plurality of upper plate openings, through the second chamber, through the plurality of lower plate openings, and then to the tube bundle.

23. A method of conveying a two-phase mixture of a liquid refrigerant and a gaseous refrigerant through the shell of a falling film evaporator, wherein the shell defines and evaporator inlet and an evaporator outlet and contains a tube bundle, the method comprising the steps of:

conveying the two-phase mixture to a first chamber within the shell;

conveying the two-phase mixture from the first chamber to a second chamber that is below the first chamber, the second chamber having a substantially rectangular perimeter;

permitting substantially unobstructed horizontal flow within the substantially perimeter of the second chamber;

conveying the two-phase mixture from the second chamber to a third chamber that is below the second chamber;

conveying the two-phase mixture from the third chamber to the tube bundle, the bundle vaporizing at least some of the liquid refrigerant to increase the amount of the gaseous refrigerant within the shell; and

conveying the gaseous refrigerant from the tube bundle to the evaporator outlet.

24. A method of conveying a two-phase mixture of a liquid refrigerant and a gaseous refrigerant through the shell of a falling film evaporator, wherein the shell defines an evaporator inlet and an evaporator outlet and contains a tube bundle, the method comprising the steps of:

conveying the two-phase mixture to a first chamber within the shell;

conveying the two-phase mixture from the first chamber to a second chamber that is below the first chamber;

conveying the two-phase mixture from the second chamber to the tube bundle, so as to vaporize at least some of the liquid refrigerant to increase the amount of the gaseous refrigerant; and

conveying the gaseous refrigerant through a plurality of suction baffle openings of various sizes to the evaporator outlet.

25. The method of claim 24, wherein the plurality of suction baffle openings include larger holes and smaller holes, and further comprising the step of placing the evaporator outlet closer to the smaller holes than to the larger holes.

26. A falling film evaporator comprising:

a shell, said shell defining a refrigerant inlet and a refrigerant outlet;

a tube bundle;

a two-phase refrigerant distributor disposed above said tube bundle in said shell and being in flow communication with said shell inlet, said two-phase refrigerant distributor having a distributor baffle and a suction baffle and receiving two-phase refrigerant from said shell inlet, said two-phase refrigerant distributor defining first, second and third chambers through which two-phase refrigerant flows prior to exiting said distributor, said first chamber causing two-phase refrigerant to flow along the length of the distributor, said second chamber causing two-phase refrigerant to be distributed across the width of said distributor and said third chamber reducing the velocity and kinetic energy of said two-phase refrigerant, said distributor baffle extending downward

from the distributor external of the sides of said tube bundle and causing refrigerant which first flows downward from the distributor to the tube bundle to follow a flow path to said shell outlet which includes a turn of greater than 90°, said suction baffle being disposed in the refrigerant flow path intermediate said turn and said shell outlet and defining a plurality of apertures, said plurality of apertures sized so as to maintain the velocity of refrigerant vapor through said turn and along the length of said distributor baffle below a predetermined velocity.